

Chapter 20: Complex #'s

20.1: Imaginary Numbers

Recall: In the set of real #'s, we can not take a sq. root of a negative

ex: $\sqrt{-9}$

* Imaginary Unit, i : $i = \sqrt{-1}$ *

Simplifying Negative Radicands

1) replace the (-) under the $\sqrt{\quad}$ with i
directly in front of the $\sqrt{\quad}$

2) Simplifying the resulting positive radican

Ex: $2\sqrt{-24}$

★ i behaves as any other variable would

$$\cdot 2i + 5i = 7i \quad \cdot 5i - 3i = 2i$$

$$\cdot 2i(3i - 2) = 6i^2 - 4i$$

★ $i = \sqrt{-1}$; Imaginary Unit

Powers of the Imaginary unit, i

$$i^0 = 1$$

$$i^1 = i$$

$$\star\star i^2 = -1 \star\star$$

$$i^3 = -i$$

$$i^4 = 1$$

$$i^5 = i$$

$$i^6 = -1$$

$$i^7 = -i$$

$$i^8 = 1$$

\star Powers of i repeat
in a pattern of --

"Clock Method"

\star "Remainder Method" \star

\div Exponent by 4 if:

(1) No decimal =

(2) .25 =

(3) .5 =

(4) .75 =

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Tools Comment

EXERCISES WITH OPEN-RESPONSE PROBLEMS

In 1–25, express each number in terms of i , and simplify.

- $\sqrt{-36}$
- $\sqrt{-100}$
- $-\sqrt{-81}$
- $2\sqrt{-49}$
- $\frac{1}{8}\sqrt{-64}$
- $-\frac{2}{3}\sqrt{-9}$
- $\frac{3}{4}\sqrt{-144}$
- $\frac{1}{3}\sqrt{-25}$
- $\sqrt{-\frac{1}{4}}$
- $\sqrt{-\frac{16}{25}}$
- $4\sqrt{-\frac{49}{64}}$
- $\frac{3}{5}\sqrt{-\frac{100}{9}}$
- $\sqrt{-3}$
- $\sqrt{-29}$
- $3\sqrt{-11}$
- $-\sqrt{-10}$
- $\sqrt{-20}$
- $-\sqrt{-28}$
- $2\sqrt{-75}$
- $5\sqrt{-8}$
- $\frac{2}{3}\sqrt{-72}$
- $-\frac{1}{2}\sqrt{-300}$
- $-\sqrt{-\frac{1}{3}}$
- $4\sqrt{-\frac{1}{8}}$
- $\sqrt{-0.72}$

In 26–35, write each given power of i in simplest terms as 1, i , -1 , or $-i$.

- i^{12}
- i^7
- i^{49}
- i^{72}
- i^{54}
- i^{99}
- i^{300}
- i^{246}
- i^{91}
- i^{2001}

In 36–57, write each number in terms of i , perform the indicated operation, and write the answer in simplest terms.

- $\sqrt{-64} + \sqrt{-36}$
- $3\sqrt{-4} + \sqrt{-121}$
- $\sqrt{-100} - \sqrt{-9}$
- $\sqrt{-16} - 2\sqrt{-4}$
- $\sqrt{-45} + \sqrt{-5}$
- $8\sqrt{-3} - \sqrt{-12}$
- $\frac{1}{2}\sqrt{-200} - \sqrt{-32}$
- $-2\sqrt{-18} - \frac{1}{5}\sqrt{-50}$
- $\sqrt{-196} - \sqrt{-225}$

Pg 924:
3-69 ÷ 3

24. $4\sqrt{-\frac{1}{8}}$

EXERCISES WITH OPEN-RESPONSE PROBLEMS

In 1–25, express each number in terms of i , and simplify.

- | | | | | |
|------------------------------|--|----------------------------|----------------------------|-----------------------------|
| 1. $\sqrt{-36}$ | 2. $\sqrt{-100}$ | 3. $-\sqrt{-81}$ | 4. $2\sqrt{-49}$ | 5. $\frac{1}{8}\sqrt{-64}$ |
| 6. $-\frac{2}{3}\sqrt{-9}$ | 7. $\frac{3}{4}\sqrt{-144}$ | 8. $\frac{1}{3}\sqrt{-25}$ | 9. $\sqrt{-\frac{1}{4}}$ | 10. $\sqrt{-\frac{16}{25}}$ |
| 11. $4\sqrt{-\frac{49}{64}}$ | 12. $\frac{3}{5}\sqrt{-\frac{100}{9}}$ | 13. $\sqrt{-3}$ | 14. $\sqrt{-29}$ | 15. $3\sqrt{-11}$ |
| 16. $-\sqrt{-10}$ | 17. $\sqrt{-20}$ | 18. $-\sqrt{-28}$ | 19. $2\sqrt{-75}$ | 20. $5\sqrt{-8}$ |
| 21. $\frac{2}{3}\sqrt{-72}$ | 22. $-\frac{1}{2}\sqrt{-300}$ | 23. $-\sqrt{-\frac{1}{3}}$ | 24. $4\sqrt{-\frac{1}{8}}$ | 25. $\sqrt{-0.72}$ |

In 26–35, write each given power of i in simplest terms as 1, i , -1 , or $-i$.

- | | | | | |
|--------------|---------------|---------------|--------------|----------------|
| 26. i^{12} | 27. i^7 | 28. i^{49} | 29. i^{72} | 30. i^{54} |
| 31. i^{99} | 32. i^{300} | 33. i^{246} | 34. i^{91} | 35. i^{2001} |

$i = \text{no decimal}$
 $i = .25$
 $-i = .75$

In 36–57, write each number in terms of i , perform the indicated operation, and write the answer in simplest terms.

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|---|--|---------------------------------|
| 36. $\sqrt{-64} + \sqrt{-36}$ | 37. $3\sqrt{-4} + \sqrt{-121}$ | 38. $\sqrt{-100} - \sqrt{-9}$ |
| 39. $\sqrt{-16} - 2\sqrt{-4}$ | 40. $\sqrt{-45} + \sqrt{-5}$ | 41. $8\sqrt{-3} - \sqrt{-12}$ |
| 42. $\frac{1}{2}\sqrt{-200} - \sqrt{-32}$ | 43. $-2\sqrt{-18} - \frac{1}{5}\sqrt{-50}$ | 44. $\sqrt{-196} - \sqrt{-225}$ |

$$42. \frac{1}{2} \sqrt{-200} - \sqrt{-32}$$